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COMPUTERS IN THE SOVIET ECONOMY

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13 April 1966Computers in the Soviet EconomyI. Introduction

The Soviet Union has not kept pace with the US in development of electronic computer technology. Obviously, this lag has not prevented the USSR from achieving spectacular results in its military/space programs. In the area of economic, business, and industrial accounting, however, the lack of electronic data processing / <sup>equipment</sup> and the rudimentary state of development of this branch of the Soviet computer industry are causing the Soviet leadership great concern. The directives for the Five Year Plan (1966-70) give a major emphasis to significantly increasing the production of computers, particularly those capable of handling large volumes of data.

The respect now shown to electronic computers by the business communities and governments of the technologically-advanced nations can be attributed primarily to the promotional work of the Free World computer producers (principally US firms) who undertook to study economic activity with a view to developing computers and computer techniques that would lighten the burden of administration. This promotional force has not found a place to date in the centrally planned economies of the communist countries, a fact that helps explain why the Soviet hierarchy is only at this late date vigorously pressing for a production program intended to equip its industrial enterprises and bureaucratic structure with computers for data processing and analysis.

Computer development work in the USSR was concentrated initially at research institutes under the Academy of Sciences, and was focussed primarily on computers

suitable for scientific calculations. Much discussion and a moderate amount of real effort has been given to the development of computer systems for process control. Heavy emphasis was placed on the development of analog and digital computers appropriate to priority military and space programs and consequently, until fairly recently, the Soviet computer industry did not have the capability to design or to produce computers especially adapted to commercial or economic applications. Little research was directed toward the development of peripheral equipment or programming devices necessary for data processing applications.

TP Owing particularly to tardiness in recognizing the value of electronic data processing computers, as well as to parsimony in the allocation of resources to their development and production, the Soviet Union today lags about five years behind the US in this area of computer technology. There is little evidence that digital computers were routinely employed in data handling roles in the USSR before 1960. Rather, they seem to have been used almost exclusively for problem solving. Following a belated awakening to the benefits that industrialized Western countries were realizing from the application of data handling computers in commercial activities, the USSR, beginning in about 1962, installed them at a slow but increasing tempo in enterprises and state administrative organs for processing plan data, scheduling production and performing accounting tasks.

In contrast, US computer manufacturers, stimulated by the sales potential of the business market, have concentrated since about 1955 on on raising operating speeds the development of expanded internal and external memory systems, on increases in assortment and efficiency of input/output apparatus and on making

their computers easier to use. Ease of use has been facilitated by provision of additional programming languages and accessibility to the computer from remote consoles. In the Free World, and particularly in the US, computers are now used in almost every phase of economic activity from market research to business accounting.

#### IV. Requirements for Computers in the USSR

Two factors have led to the recognition by Soviet officials in recent years of a greatly increased requirement for computers for the Soviet economy. One factor has been the growing difficulty of contending with the flood of information that accompanies growth in economic activities. The other is the strengthening conviction of Soviet planners that resource allocation can be better managed by mathematical methods.

It is obvious that the successful operation of a centrally controlled, highly industrialized economy depends on the ability to analyse vast amounts of data. In the Soviet Union, the collection, processing, transmission, storage, and arrayment of data on every aspect of economic life, transmitted between production, distribution and sales units and production control, statistical, and planning centers at various levels of authority, through multifarious channels, presents a data processing task unparalleled in human experience. This task is done inefficiently at the present time (principally by vast numbers of clerks armed with abaci and desk calculators). Even punch card machinery, which has been in production for years in the USSR, contributes relatively little compared with the army of clerks. In 1962, the Soviet system of accounting and statistical

collection alone employed about three million persons, quite apart from the hordes employed in the planning system, the material technical supply system, and the financial and banking system.<sup>1/</sup> Moreover, the volume of data on economic activity to be reported tends to proliferate at a disproportionately higher rate than the growth of economic activity. The preservation of the centralized system of economic management in the USSR depends on, among other things, achieving a very considerable increase in labor productivity in the processing of data.

1. In Economic Planning and Control

The idea of using mathematical methods to allocate resources for maximum output was discussed by Kantorovitch <sup>2/</sup> in 1939. The increasing complexity of the planning process has engendered active interest in these methods. Given valid statistics and simplified economic models, mathematical methods would permit testing draft plans for inconsistencies and imbalances. Implementation of the advanced concept of cybernetic control of the economy, which envisions the drafting of plans, issuing of instructions and regulation of plan implementation down to the enterprise level by computers in a completely automated manner, is not being seriously considered. Such a program would have not only an enormous requirement for very fast computers with very large memories as a necessary condition for its implementation but would also deny virtually all significant economic decision making at the enterprise level. The supply of the necessary computer

<sup>1/</sup> A.I. Kitov and Iu. I. Cherniak; "Avtomatizatsiia upravlencheskikh rabot", Avtomatizatsiia Proizvodstva i Promyshlennaiia Elektronika, Vol. I, pps. 26-32.

<sup>2/</sup> Academician L.V. Kantorovitch, formerly at the Leningrad Branch of Mathematics Institute imeni Steklov of the Academy of Sciences, USSR is now the Director of the Laboratory of Mathematical-Economic Methods of the Institute of Mathematics of the Siberian Department of the Academy of Sciences, USSR in Novosibirsk.

capacity ~~to satisfy the first condition~~ would be too great a drain on Soviet industrial resources to be practical in the foreseeable future, and the implied increased interference with the process of optimizing production at the enterprise level would run counter to current policies.

The satisfaction of most of the USSR's requirements for computers for processing economic information are envisioned in a program officially adopted by a decision of the Central Committee, CPSU, and the Council of Ministers, USSR, for implementation in the Five Year Plan (1966-70). 3/ This program, the culmination of proposals now rather well known to students of the Soviet economy, calls for the creation of "a state network of computer centers for the collection and processing of economic information and the solution of problems of planning and control in the national economy." 4/ The existing network of the state statistical system, which has computing centers and machine calculating stations in all-union republics and oblast and kray centers, as well as more than 650 machine calculation stations in administrative regions and cities, is to be expanded and supplied with modern computing equipment, and will form the base of the state network of computer centers. Along with the state network of computer centers, sectorial and departmental systems of planning, accounting, control, and information processing will be created as necessary and interconnected with the state network. 5/ Presumably these sectorial and departmental networks will encompass the computers in enterprises and in groups of

3/ Decree of the Central Committee, CPSU and Council of Ministers USSR, published in Izvestiya, 20 March 1966, p. 2.

4/ V. N. Starovskiy, Chief Central Statistical Administration, USSR, Ekonomicheskaya Gazeta, No. 13, March 1966, p. 25.

5/ Ibid.

enterprises where the basic economic information is generated. The final consolidation and arrayment of economic information for the use of top planners *with an economic model of limited size* will presumably be accomplished on the computers of the Central Statistical Administration USSR, which "is now making ready for the compilation of a detailed intersectorial balance of the production and distribution of the social product on the basis of the report data for 1966." 6/

In a recent *article* ~~discussion of this scheme~~, Dorodnitsyn 7/ has estimated that more than 4,000 medium to large-sized computers would be required to equip such a network. It is doubtful that there are more than 3,000 digital computers presently installed in the USSR, of which only a *minority* ~~few~~ are so deployed that they would belong to this system. 8/ Although it has been acknowledged that the Soviet computer industry could not completely install the system in the 1966-70 Five Year Plan 9/, increments toward its completion will considerably improve efficiency in data handling at all levels of the economy, and will give many enterprise managers an increased capability to reduce costs and increase output.

*2. At the Enterprise Level*

The need for data processing computers at the enterprise level is especially

great, not only because at this level most of the data for planning and controlling the economy are generated and must be consolidated and transmitted upward, but also because computers can be profitably used for inventory and production control, *invoicing*, A

6/ Ibid.

7/ Academician A. Dorodnitsyn, head of the Computing Center, Academy of Sciences of the USSR, in an article in Pravda, 23 February 1966.

8/ A total of nearly 28,000 general-purpose digital computers had been installed in the US by the end of 1965 according to Electronic Intelligence Digest, 10 February 1966.

9/ V. A. Kirillin, Chairman of the State Committee for Science and Technology, in a speech broadcast from Moscow, 1 January 1966.

payroll accounting, and the solution of complex engineering problems.

Soviet interest in applying electronic data processing to the problems of industrial management was highlighted in March 1965 when V. D. Lebedev, then Deputy Chairman of the USSR Sovnarkhoz, announced plans to modernize management techniques by installing computers at 119 plants and combines during 1965 and 1966. These plans are a natural consequence of the recently intensified interest of the Soviet leaders in improving the efficiency of industrial management. Such interest is epitomized by the findings of the Collegium of the USSR Sovnarkhoz, which met in August 1964 to discuss the introduction of computing equipment and quantitative economic methods into industrial management. The Collegium concluded that major attention should be given to "the comprehensive mechanization of engineering and administrative labor, including engineering and design calculations, norm (work standards) setting, planning, ~~a~~ material and technical supply, economic information, accounting, analysis of production activity, etc." 10/ About 100 plants are currently so equipped and these are considered pilot projects.

The USSR has shown an interest in the application of computer control to industrial processes since the early 1950's when a rapid increase in industrial productivity through automation became an important national goal. Nevertheless, this program has proceeded in a very limited way, probably largely because of slowness in completing applied research on the processes to be controlled.

10/ Ekonomicheskaya Gazeta, No. 37, 12 September 1964, p. 37.



1 Among the industrial processes to which computers have been applied in the  
2 USSR since 1957 are chemical and petrochemical productions, electric power  
3 distribution, steel smelting and rolling, and train dispatching. Although  
4 Soviet industry continues to lag behind US industry in the application of  
5 computers to industrial automation, increases in computer production and  
6 research on applications in Soviet industry are contributing to the number and  
7 variety of computers for process control. Moreover, particular emphasis on the  
8 need for process control computers is given in the directives for the Five Year  
9 Plan for 1966-1970.

10 The requirements of the service industries, e.g., transportation, construc-  
11 tion, electric power, have been little satisfied so far by the ~~paltry~~ few  
12 installations of computers presently working out linear programs in these areas.  
13 The success of these applications is reflected in plans for greatly expanding  
14 the production of the appropriate computers.

15 Keeping in mind that digital computers for installations supporting  
16 military/space activities have first claim on Soviet computer production, that  
17 many machines are needed by scientific institutes not employed in direct support  
18 of military/space activities, and, further, that many of the existing machines  
19 are of obsolete design, slow, difficult to maintain, and ~~mg~~ ought to be replaced,  
20 it can be estimated that equipping the economy with the necessary data processing  
21 equipment will be a protracted task.

22 Production

23 The production of digital computers was carried out on a laboratory scale

for quite a long time in the USSR, with production on a commercial scale beginning about 1957. Consequently, although high rates of increase in output are achieved every year, the shortage of computers remains acute. The following table compares estimated production of computers in the USSR with the US. It can be seen that, although a higher growth rate is estimated for the Soviet Union, the lead of the US in absolute terms increases every year. During the Soviet Seven Year Plan (1959-65) the production area at the major computer plants <sup>was</sup> ~~were~~ greatly expanded. It is expected that the high priority now accorded the production of computers will continue through 1970.

## Comparison of US and USSR Production of Computers and Data

Processing Equipment, a/, 1958-65

Millions of Current US Dollars b/

	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>Average Annual Growth Rate 1958-65</u>
US	410	490	630	895	1,065	1,240	1,375	1,585	21.3%
USSR	35	45	55	70	95	120	140	200	29.3%

b ~~/~~. Rubles have been converted to dollars at the rate of 1 R = US\$ 0.75.

a ~~/~~. Neither the estimates of production for the US nor for the USSR include special purpose military computers.

Although, in the early years of production, analog computers were <sup>dominant</sup> ~~dominated~~, the product mix in the USSR, as in the US, is now heavily weighted in favor of digital computers. Most of the digital computers in production are of the general purpose type, although an increasing number of special purpose designs are in serial production for use in industrial control or industrial planning operations. The Soviets <sup>Union</sup> ~~produce~~ produces very few general purpose digital computers that

would be considered large by US standards. Until 1965, most computers produced in the USSR were similar to those in production in the US during the period 1954-60. In 1965 the USSR introduced a number of new models of general purpose digital computers, such as the BESM-6, MINSK-22 and MINSK-23, RAZDAN-3, and URAL-11, URAL-14 and URAL-16. Most of these embody the memory size, high operating speed, and peripheral equipment necessary for data processing applications. They represent a significant advance in both technology and capacity and should be in production for the next few years. The BESM-6 is the largest and fastest known Soviet computer, and is claimed capable of averaging one million operations per second. It is not likely to be generally available in significant numbers in the next year or two. The URAL and MINSK machines are typical of the new production models of computers that are likely to be available for general purpose uses in the immediate future. 11/

It was not until 1961-62 that the first transistorized computers were introduced in the USSR, compared with 1958-59 in the US. Although all models of Soviet computers brought into production since early 1964 have been transistorized, the production of electron tube-type computers was not completely discontinued until

11/ Professor Andrei P. Yershov, head of the Computer Center Programming Department, Siberian Division, Soviet Academy of Sciences, Novosibirsk told a meeting of the <sup>Aviation for Computing Machinery</sup> in Culver City, California in June 1965 that the BESM-6 has a core memory of 16-32,000 words of 48-bit length and an access time of 2 microseconds. A high degree of parallelism permits an average performance of one million instructions per second. The computer will cost about 3 million rubles and can be used for time sharing operations. Yershov described the URAL-16 as having both fixed and floating <sup>decimal</sup> point, a 48-bit word length, 50,000 operations per second, a core memory of 8-64,000 words, memory accesstime of 9 microseconds, and a drum memory of 130,000 words. (Extracted from Electronic News, 7 June 1965)

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1 1965. There are no indications of production of third generation computers, i.e.,  
2 those with integrated circuitry, representative of the latest state-of-the-art  
3 in the US. In fact, the development of integrated circuit components for elec-  
4 tronic computers has been identified by Kirillin 12/ as a major assignment for  
5 the electronics industry in the plan for the next five years (1966-70).

6 A dearth of peripheral equipment has persistently plagued Soviet computer  
7 users who have data handling requirements. This is, as mentioned above, a con-  
8 sequence of the long delay in recognizing the need for computers for data handling  
9 tasks. The peripheral equipment described in connection with the newly announced  
10 digital computers includes auxilliary memories of magnetic tape and drum types,  
11 improved page and line printers, and better punch card and paper tape readers.  
12 Unfortunately for the USSR, the quality of this peripheral equipment still leaves  
13 very much to be desired. Dorodnitsyn 13/ considers the lag of Soviet technology  
14 in this area to be too great to be satisfactorily overcome in an acceptable period  
15 of time through domestic research and development and recommends importing the  
16 necessary equipment or licenses to produce it. He reasons that the cost of  
17 acquiring it in this way would not greatly exceed the cost of domestic production  
18 (including research and development costs) and that any additional costs are justi-  
19 fied by the importance of shortening the delivery period.

20 Continued rapid growth of the industry is independent on the availability of  
21 investment capital, components and trained labor. The component supply has  
22 12/ V. A. Kirillin, op. cit.  
23 13/ Academician A. Dorodnitsyn, op. cit.

probably been somewhat eased by the rapid growth in production of semiconductors, which according to an official source, increased by 40 percent in 1965. <sup>14/</sup> There are reports, however, that the quality of transistors used in Soviet computers is below world standards for this purpose. The provision of the skilled labor required for computer production has been a persistent problem and is likely to be a continuing one. The necessity for using labor with inadequate skill tends to reduce productivity in the Soviet computer industry and to contribute to a low quality product and excessive maintenance for the user.

V. Institutional Problems

Several factors inherent in the organization and operation of the Soviet economic system tend to preclude optimum application of computers. Soviet production philosophy tends to emphasize series production of a minimum assortment of standardized models to the detriment of users who need computers tailored to their particular requirements. Moreover, when a standardized computer has become obsolete, and a replacement model more responsive to user needs has been developed, the production of the obsolete model usually continues for an excessively long period. This situation is chronic in all Soviet machine building industries because the production loss incurred by a plant in changing models typically leads to losses of bonus payments to the management and the work force. Delay in the appearance of improved models also has occurred because of poor communications resulting from bureaucratic separation of computer users, producers, and designers. This situation can be contrasted with that in the US where the producer not only <sup>14/</sup> A. I. Shokin, Minister of the Electronics Industry, Izvestiya, 4 January 1966.

[REDACTED]

1 is also the designer, but frequently has his representative physically present  
2 on the user's premises to maintain the computer and provide direct liaison between  
3 user and designer.

4 In the USSR, very few services presently accompany the sale of a computer.  
5 The customer receives limited instruction in programming, operating and main-  
6 taining his computer, but once it has been installed the manufacturer takes no  
7 further responsibility for its maintenance. Spare parts are often unobtainable  
8 from the computer manufacturer and even from component manufacturers, and the  
9 user is forced to employ makeshift expedients to keep his machine operating.  
10 Such makeshift repairs may change the operating characteristics of the computer  
11 enough to prevent the sharing of programs among users of the same model.

12 Even before the decree for establishing a state network of computer centers  
13 was announced, measures to correct these deficiencies <sup>had</sup> ~~have~~ been undertaken in  
14 the USSR. As recognition of the seriousness of the losses in computer working  
15 time became stronger, several official bodies were established to investigate  
16 difficulties in the utilization of computers, to make suggestions for further  
17 research and to oversee servicing arrangements. At the national level, repre-  
18 sentatives of the Ministry of the Radio Industry, of the Ministry for Instrument  
19 Making, Means of Automation and Control Systems, and the State Committee for  
20 Science and Technology confer among themselves and with representatives of the  
21 Academy of Sciences and Ministries in which computers are employed, in order to  
22 decide which newly developed models should be scheduled for production. At the  
23 republic level, computer producers, design facilities and computer users <sup>have been</sup> ~~were~~

formed into production-engineering associations, concerned with advising one another on the problems of planning, designing, producing, installing, and using the computers located in the particular republic.

The production-engineering organizations and the scientific research institutes have been playing a major role in the job of assimilating computers into the economy. Between them, they carry out the function that is achieved in the US by manufacturer's sales and service representatives and by private data processing service organizations. Several new cybernetics institutes and economics-engineering institutes have been founded in the USSR in the last few years to create computer programs, perform systems engineering for process control applications, design forms for economic reporting, and train applications and programming personnel.

The above measures are to be intensified and expanded ~~for~~ under the provisions of the decree on the state computer network, according to Starovskiy. <sup>15/</sup> The decree provides that installation, adjustment, and putting into operation of the systems and equipment of the state computer network will be contracted out to a new organization, the All-Union Planning and Installation Administration, now being organized under the Ministry of Instrument Making, Automation Equipment and Control Systems. This administration is to have a network of territorial planning sections and installation administrations and will maintain cost accounting on its operations. The Ministry of the Radio Industry is charged with the installation, adjustment, putting in operation, and servicing of all computers and accessories which its enterprises produce. Apparently, the All-Union Planning

<sup>15/</sup> V. N. Starovskiy, op. cit.

1 and Installation Administration is to have a general contractor's role on  
2 total systems and the Ministry of the Radio Industry will be held responsible  
3 for the installation and correct functioning of its computer equipment. It is  
4 intended that the computer centers will keep books on their operations. Hence,  
5 it seems likely that an arrangement will be established under which computer  
6 centers will pay computer producers for servicing their computers. Such a  
7 system would enhance the probability that service would indeed be rendered.

8 Concern in the USSR with the difficulty of maintaining computers in the  
9 absence of a conscientious program by manufacturers to provide service after  
10 sale is probably responsible for a recommendation made recently by Dr. O.  
11 Kozlova, 16/ Professor of Economic Sciences. She asserted that it is rational  
12 to lease automatic data processing equipment to enterprises and let the manu-  
13 facturer assume full responsibility for installing, adjusting and maintaining  
14 it. This is, of course, the most common marketing arrangement employed between  
15 computer makers and users in the Free World.

16 The Soviet propensity for maximizing production rather than satisfying  
17 users' needs has resulted in the design of computers that are difficult to use.  
18 Soviet computers generally cannot accept instructions in timesaving "programming  
19 language" (such as FORTRAN), and the Soviets have not provided the input/output  
20 equipment needed for the use of the automatic language compilers and translators  
21 that are standard in US practice. Soviet programmers have had to prepare instruc-  
22 tions in numerical form, a time consuming process. Moreover, the US practice of  
23 providing computer users with standard programs for frequently run problems is

16/ O. Kozlova, Pravda, 4 March 1966.



seldom employed in the USSR, with the result that much time is spent in  
redundant programming work. Recently, some steps have been taken to correct  
these deficiencies. Language compilers for some of the new computers are  
being developed, a central repository for programs for mathematical problems  
has been created at the State Scientific and Technical Library, and several  
economic research institutes are compiling standard programs for common accounting  
and control problems in commerce and industry. Under the decree for establishing  
the state network of computer centers, it is planned that responsible departments  
and scientific institutions will continue this work and will provide libraries  
of standard programs, autocodes and algorithmic language translators. However,  
the success of these programs will depend on the provision of necessary input/output  
equipment.

The efficient use of computers is impeded in the USSR, not only because of  
the lack of conveniences for programmers, but because of a severe shortage of  
qualified personnel for maintenance and programming. Technical and economic  
institutes have established courses to train people in the application, programming  
and maintenance of computers. However, the number of students enrolled continues  
to be inadequate compared with the present requirements, and more steps will  
have to be taken to prevent a severe shortage of skilled personnel when the  
expected rapid increase in the installation of electronic data handling equipment  
occurs.

The USSR recognizes the wide application of computers in the economy not  
only as an attractive means of significantly reducing the cost of economic

planning and management but also as the necessary means of retarding the rapidly mounting rate of absorption of manpower into non-productive data handling tasks. The Soviet planners realize that they are tardy in developing the technology for applying computers to data processing. The correction of their backward position in this respect has been given great emphasis in the directives for the next Five Year Plan (1966-70), but with the explicit acknowledgement that five years is too short a period in which to complete a national system of data processing computers adequate to handle the statistical reporting needs of the economy. It is expected that the problem of equipping the economy with computers will still be a priority national problem at the end of this five year plan period.

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